LARVAE OF NEOTROPICAL COLEOPTERA. XXVII. *PHRIXOTHRIX HIRTUS:* IMMATURES, NEOTENIC FEMALE, ADULT MALE AND BIONOMIC DATA (PHENGODINAE, PHENGODIDAE, COLEOPTERA)

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ABSTRACT

The last instar larva, male and female pupae, male and female adults of *Phrixothrix hirtus* Olivier, 1909 from Costa Rica in the limit between the States of Goiás and Mato Grosso do Sul and from Ilha dos Alcatrazes in the littoral of São Paulo, Brazil, are described and illustrated. Adults and pupae were obtained by rearing larvae in the laboratory. Bioluminescence spectrum was detected for all life stages. The **in vivo** spectra for the lateral lanterns of all stages are essentially similar. Also, the larval and adult females head lantern bioluminescence spectra are identical.

KEYWORDS. Bionomics, immatures, paedomorphosis, Phengodidae, *Phrixotrix hirtus*.

INTRODUCTION

Phrixothrix Olivier, 1909 comprises 29 species found in the Neotropical region from Costa Rica to Argentina and **ca.** 12 species known from Brazil (Wittmer, 1963, 1976, 1988, 1992).

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Immatures of the genus *Phrixothrix* are still poorly described. HAASE (1888) studied the larva, the larviform female and the male of *P. hieronymi* (HAASE, 1886), a very common species from Argentina. TIEMANN (1970) presented many data on the natural history of a species of *Phrixothrix* found in São José dos Campos, SP, described by WITTMER (1970) as *P. tiemanni*. COSTA **et al.** (1988) described the larva of an undetermined species of this genus. VIVIANI & BECHARA (1997) presented many data on the bioluminescence and biological aspects on 17 Brazilian railroad-worm species in eight genera, among them five species of the genus *Phrixothrix*. They studied a larva from Campinas, SP, misidentified by association with an adult of *P. hirtus* Olivier, 1909 collected in the same area; however that larval specimen belongs to a different, unidentified species. The authors also studied a larva, a male pupa and a male adult misidentified as *P. heydeni*, but those specimens actually belong to *P. hirtus*.

We studied the material of *Phrixothrix hirtus* Olivier, 1909 collected near the Parque das Emas, listed in VIVIANI & BECHARA (1997), but adding more recently collected specimens specially of the female adult and male and female pupae. We studied also larvae, neotenic females and male adults from Ilha dos Alcatrazes in the littoral of São Paulo, Brazil. Additional adults and pupae were obtained by rearing larvae in the laboratory. *Phrixothrix hirtus* is the first phengodid species in which the bioluminescence spectrum was detected for all life stages. The **in vivo** spectra for the lateral lanterns of all stages are essentially similar. Also, the larval and female adults head lantern bioluminescence spectra are identical.

Phrixothrix hirtus Olivier, 1909

(Figs. 1 - 61)

Phrixothrix hirtus OLIVIER, 1909: 345 (holotype ♂, Muséum D'Histoire Naturelle, Paris, not examined; type locality: Paraguay); OLIVIER, 1910: 9 (cat.); BLACKWELDER, 1945: 362 (cat.); WITTMER, 1963: 78; 1988: 73.

Male adult (figs.1-22). Length 15-19 mm. Body mainly yellow, excepting head which varies from dark reddish brown to almost black. Vestiture formed by dense, elongate setae, concolor with integument.

Head transversal, about 0.6 times as long as wide, sparsely punctate, punctures coarser and deeper on labrum, lateral and posterior margins. Eyes oval, bulging, separated by distance of 1.7 times of largest eye diameter. Frons slightly depressed. Labrum light reddish brown, anterior margins rounded, with a deep, nearly circular median notch (fig.11). Antennae light yellow, densely setose, about 1/4 of body length, 12-segmented, segments 4-11 doubly plumose (fig. 8), rami gradually increasing in length to 9th segment, then progressively decreasing towards 11th segment. Mandibles (figs. 2,3) reddish yellow to reddish brown, falcate, slender, apices acute, setose on dorsolateral basal half. Maxillae (fig. 10): palpi 4-segmented, 1st shortest, 2nd longest, 3rd and 4th subequal in length, but distal segment securiform, apex about 2.5 times as wide as base width; galea and lacinia distinct, forming two subequal lobes, each one with a dense fringe of setae. Labium (fig. 7): prementum transversal, anterior margin nearly straight; palpi 3-segmented, 1st shortest, 2nd and 3rd subequals in length, distal segment wider

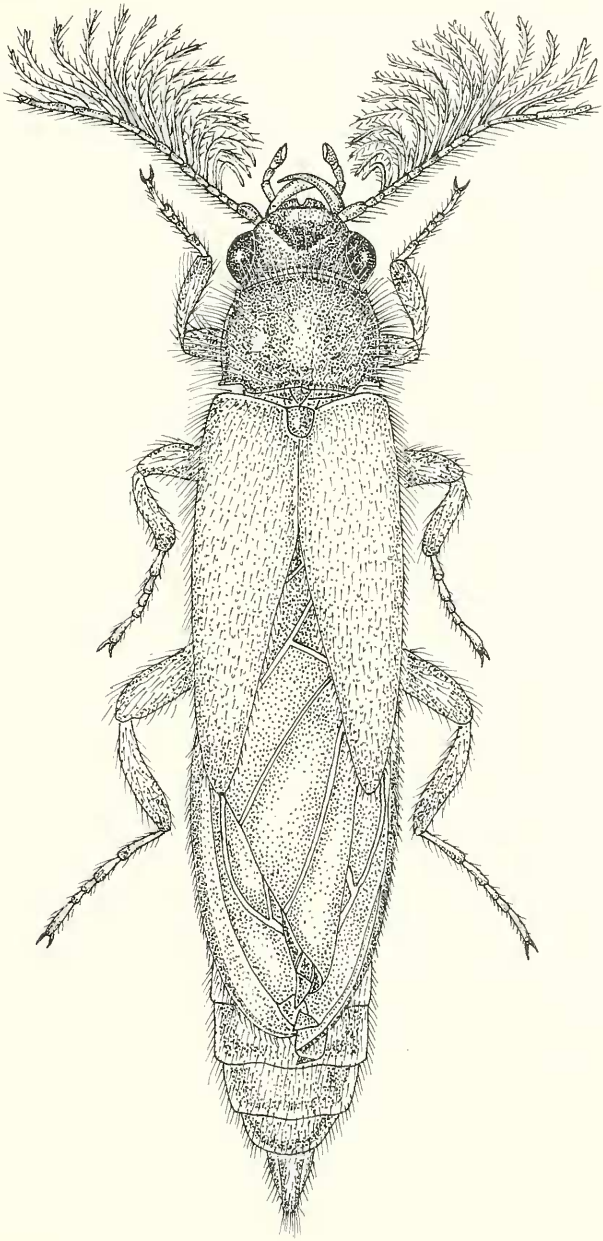


Fig. 1. *Phrixothrix hirtus*. Habitus, adult male from Costa Rica, MS. Length 17 mm.

near middle. Epipharynx setose (fig. 9), setae forming a dense tuft in each anterolateral side; with two rounded, contiguous sensilla, medially placed near anterior margin. One tentorial pit well visible, placed in a deep depression.

Pronotum transverse, about 1.3-1.4 times as wide as long, anterior margin curved, narrower than posterior one; lateral sides constricted posteriorly, forming acute, produced hind angles; posterior margin sinuous, with a weak median notch; surface smooth, punctures shallow and sparse.

Elytra triangular, short, about 3.4 times as long as pronotal length, their apices only attaining posterior margin of ventrite III (lateral view); discal portion of anterior 1/3 or 1/2 smooth, margins and remainder distal portion roughened and opaque. Scutellum quadrangular, margins weakly curved.

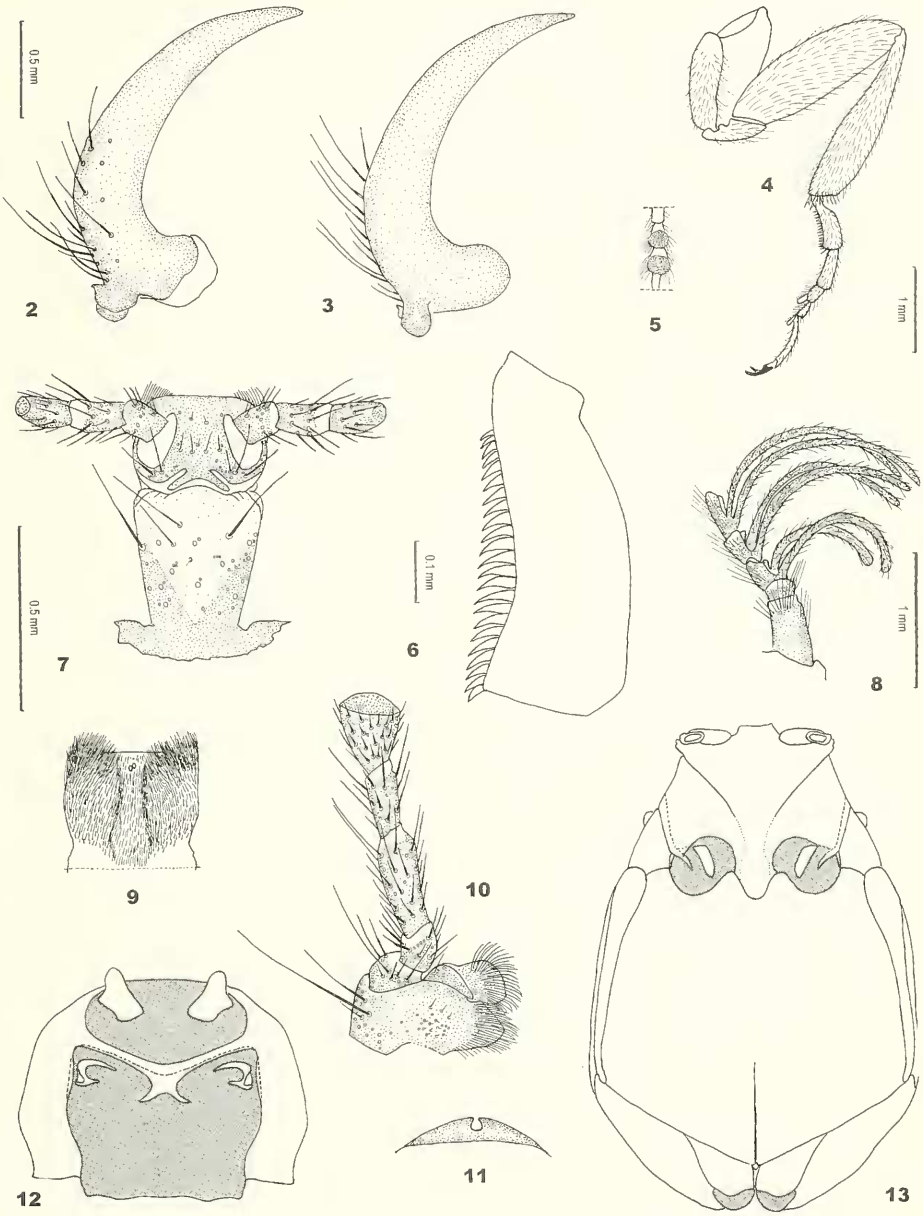
Metathoracic wing (fig. 14) about 2.2 times as long as wide; radial cell closed, nearly 6.5 times as long as wide; r_4 crossvein well marked; wedge-cell absent; medial field (posterior to MP_{1+2}) containing 4 veins in main group (not including AP_{3+4}): MP_3, MP_4, CUA_2 and AA_{3+4} (veins terminology according to KUKALOVÁ-PECK & LAWRENCE, 1993).

Legs (fig. 4). Yellowish, setose, progressively increasing in length from anterior to posterior one; tarsomeres 3th and 4th of all legs with a ventral, rounded, densely setose lamella (fig. 5); 1st tarsomere of anterior and median legs with a row of 23 stout, curved, aligned setae (fig. 6).

Underside. Prosternum (fig. 12) very small, procoxal cavities large and open behind; eutrochantins exposed, hook-shaped; laterocervical sclerites bilobed, produced over base of head. Mesosternum (fig. 13) small, median region membranous; mesotrochantin narrow and exposed; mesocoxal cavities separated by distance equal to 1.8 times of mesocoxa diameter. Metasternum (fig. 13) large, trapezoidal; longitudinal suture short and extending about 1/3 of metasternal length (0.38 times); metendosternite (figs. 16,17): furca (f) with stalk (s) well-developed, very narrow and elongate, with a conspicuous, nearly central indentation, broadening out forward into a small, lobe-like lamina (l), and then narrowing abruptly to apex; tendons indistinct.

Male terminalia. Sternite IX (fig. 18) elongate-oval, about 2 times as long as wide, densely setose in distal 2/3; proximal 1/3 membranous and glabrous; distal margin with a median, deep, U-shaped notch. Tergite IX (fig. 15) transversal, about 1.8 times as wide as long, distal margin sinuous at middle. Tergite X (fig. 15) elongate, about 1.4 times as long as wide, lateral margins gradually tapering towards apex; apex with a dense tuft of elongate setae. Aedeagus (figs. 19, 20) trilobed: basal piece very small, ribbon-like; median lobe cylindrical, about 10 times as long as wide, strongly curved at base, strongly constricted distally and forming a bulbous apex which presents many tiny glandular openings; flagellum, at rest, encircled around median lobe; when distended about as long as median lobe length; apex of flagellum trapezoidal (fig. 21); parameres elongate-oval, narrowed to apex, setose and bidentate in the inner side (fig. 22).

Female adult (figs. 23-35, 60, 61). Length 34 mm; width of pronotum 5 mm. Larviform (figs. 23, 24), orthosomatic, less depressed than mature larva, integument and pilosity yellowish, very similar to the mature larva, except for the following characters: stronger punctures on head and flattened scale-like ornamentations more



Figs. 2-13. *Phrixothrix hirtus*. Adult male from Costa Rica, MS: 2, mandible, dorsal; 3, mandible, ventral; 4, left mesothoracic leg; 5, idem, detail of 3rd and 4th tarsomeres, ventral; 6, idem, detail of 1st tarsomere; 7, labium; 8, antennomeres I-V; 9, hipopharynx; 10, right maxilla, ventral; 11, labrum; 12, prothorax, ventral; 13, meso- and metathorax, ventral. Scale: figs. 2,3,10; 7,9; 4,5,12,13; 8,11, respectively to same scale.

evident (fig. 28); ventral area of mandibles with dentiform microtrichia; dorsal region of maxillae with longer setae; epipharynx (fig. 31) with denser microtrichia; hypopharynx formed by a simple, membranous lobe, clothed with short hairs; hypopharyngeal sclerome (fig. 29) weakly sclerotized, aparently not associated with mandibles, clothed with microtrichiae forming oval patches and apical fringe of ramified setae; annular spiracles (fig.25) present on mesothorax and abdominal segments I-VIII; sternite IX with a large transverse ooporus (fig. 30); anal opening bearing two transversal dark sclerotized lamellae (fig.30).

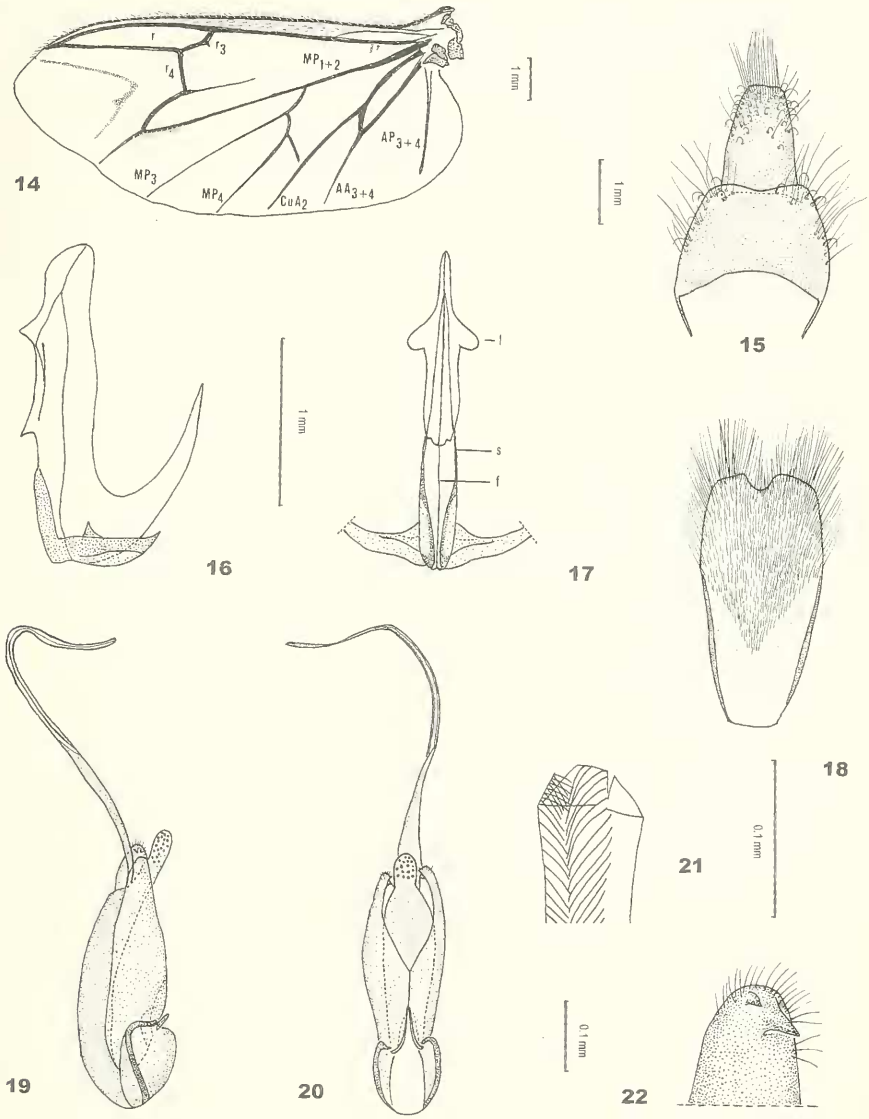
Internal reproductive system (figs. 33-35) consisting of a pair of ovaries connected with a pair of assymmetrical oviducts which join to form a median oviduct opening into vagina; bilobed spermatheca continuing as a small weakly sclerotized pouch that opens into vagina near common oviduct. Ovaries lying between abdominal segments IV to VIII (fig. 32); right oviduct longer than left one. Gonopore or ooporus situated on the sternite IX; other special structures associated with oviposition, absent.

Male pupa (figs. 36-37). Length 20 mm. Cream, densely covered by ferrugineous setae, shorter and sparser on segments VIII-IX. Head invisible from above. Pronotum transverse, rectangular, fore angles bearing dentiform projection forward; hind angles bearing cylindrical robust divergent projections, with truncate apex; a pair of rounded ventral spiracles located at apex of small tuberculiform projection. Mesonotum 1/2 of metanotum length. Segments I-VII transverse; segment VIII narrower; segments I-VIII bearing paired lateral rounded spiracles located at apex of small tubular tubercle. Tergites IX-X, sternite IX and aedeagus partially extroverted.

Female pupa (figs. 58, 59). Larviform, similar to larva and adult female, but integument lighter and less pilose; mandible not sulcate, broad, triangular shaped, shorter than in larva and in the female, not falciform, large dorsal seta not spatulate, retinaculum indicated as an indentation in the mesal margin; spiracles annular; antenna proportionally smaller than in larva and neotenic female; ooporous indicated as a weak transversal carina in the sternite IX.

Mature larva (figs. 38-57).Length 36 mm; width of pronotum 4 mm. Orthosomatic, depressed (fig.38). Integument moderately sclerotized, brownish covered dorsally and ventrally by long, dense and ferrugineous setae (ventral shorter); head and segment X more sclerotized; head reddish-brown with black area around stemmata; segment X brown.

Head prognathous, half the width of pronotum base, depressed, retractable. Epicranial suture (fig.44) absent. Endocarina absent. One stemma on each side of head below antenna (figs. 44,45). Labrum (fig.44), bilobed, separate of frons by a weak suture, bearing 2 long setae on each side, each one with long basal channel. Each side of frons 2-lobed: inner lobe with margin slightly sinuous, bearing 8 setae (1 short), each one with a long basal channel; outer lobe rounded, bearing 1 seta on right side and 2 (broken) on left side. Epipharynx (fig. 48) with microtrichiae and 2 sensory pores on each side, near base. Cephalic capsule (fig.44) bearing setae of varied size, more concentrate near stemmata and antennal base, and short setae distributed irregularly dorsal- and ventrally.



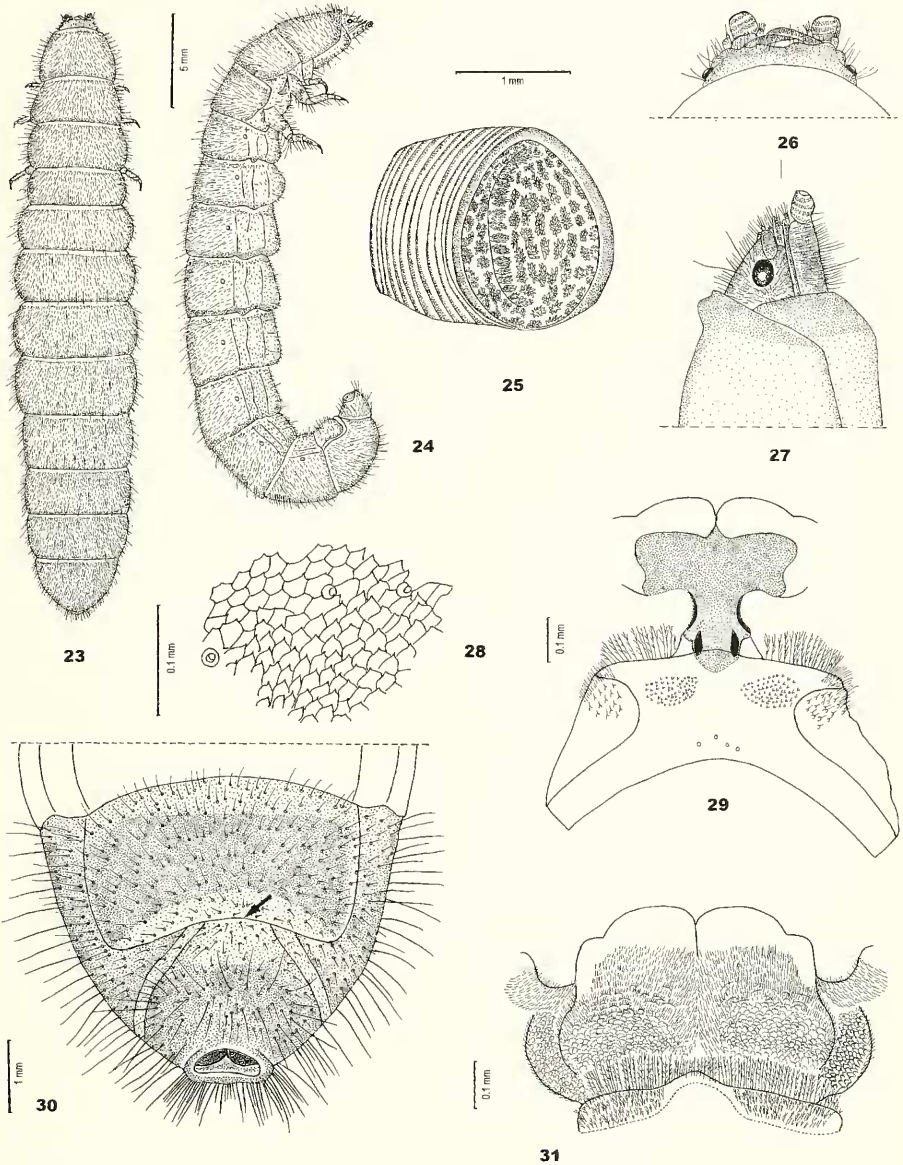
Figs. 14-22. *Phrixothrix hirtus*. Male adult from Costa Rica, MS: 14, metathoracic wing; 15, tergites IX and X; 16, metendosternite, lateral; 17, metendosternite, ventral (f-furca, l-lamina, s-stalk); 18, sternite IX; 19, aedeagus, lateral; 20, aedeagus, ventral; 21, apex of flagellum; 22, apex of paramere, inner view. Scale: figs. 15, 18-20; 16,17, respectively to the same scale.

Antennae (figs. 46, 49) 3-segmented; basal segment telescopic (extended in fig. 45), bearing 2 dorsal sensory pores and 3 ventral near apex; median segment longer bearing laterodistally a well developed sensorium inside a membranous area surrounded by 2 moderately long setae and 3 sensory pores, and 1 stout dorsal seta; distal segment reduced, slightly elongate, bearing 2 very long, 3 moderately and 3 short setae at apex. Mandibles (figs. 50, 51) falciform, dorsally channeled from base to near tip, bearing 1 long spatulate seta near apex and 2 short setae and 3 sensory pores near middle; with a well distinct triangular retinaculum. Maxilla (figs. 45-47): stipes elongate, setose, lateral margins rounded; cardo partially membranous; galea 2-segmented, distal segment bearing 1 stout and several simple setae; lacinia lobed, dorsally bearing 2 setae; maxillary palp 4-segmented; segments band-like; basal segment, the longest, bearing ventrally near anterior margin 5 laterointernal and 1 near middle setae and 1 sensory pore near laterosternal margin; 2nd segment bearing 1 sensory pore near lateral margin; 3rd bearing ventrally 2 laterosternal setae and dorsally, 8 setae near anterior margin and 2 laterointernal sensory pores near base; distal segment bevelled, partially membranous, bearing ventrally 2 median sensory pores at basal margin, dorsolaterally several sensorial slits, and distally many small sensoria. Labium (fig. 45): prementum narrowed basad, bearing many setae of varied size; postmentum elongate and setose; ligula (figs. 52, 53) membranous, well developed, bearing 2 long distal pedunculate setae, ventrally with 2 lateral sensoria near base, dorsally covered by microtrichiae and bearing 2 tuberculiform sensoria near anterior margin and 2 lateral elliptical, below them. Labial palp 2-segmented; basal segment transverse bearing 2 laterointernal dorsal and 1 ventral setae; distal segment elongate bearing ventrally 1 tiny seta and 1 sensory pore, and dorsally 1 laterointernal seta; apex bearing many sensoria. Hypopharynx (figs. 47, 53) forming a simple membranous lobe densely covered by microtrichiae. Gular sutures absent.

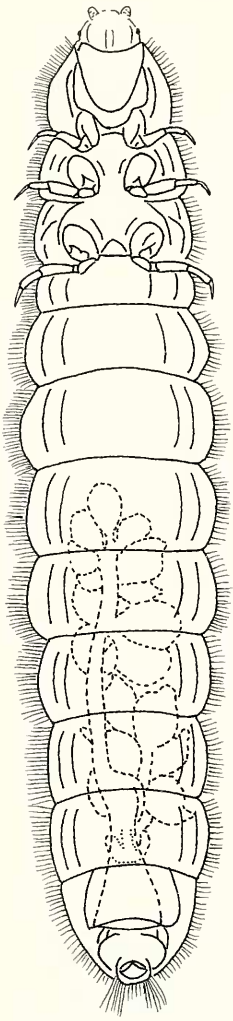
Pronotum transverse, narrowed apicad; meso- and metanotum similar in length. Mesothorax with a pair of ventrolateral anterior biforous spiracles. Legs (fig. 39) increasing in size from pro- to metathoracic, 4-segmented plus a pointed tarsungulus; coxae elongate, wider at base, bearing simple setae of varied size; trochanter subtriangular, femora and tibiae elongate; trochanters, femora and tibiae bearing simple and stout setae of varied size (stout setae shorter); tarsungulus (figs. 40, 41) bearing 1 stout and 1 simple long laterosternal seta.

Abdominal segments I-IX transverse; segments I-VIII laterally bearing paired biforous spiracles (fig. 42), smaller than thoracics; segment IX slightly narrowed apicad with rounded apex; segment X (fig. 43) strongly sclerotized with membranous apex, tubular and setous, ventrally forming a median tooth. Anal slit transverse.

Material examined. BRAZIL. **Mato Grosso do Sul:** Costa Rica, Fazenda Santa Cruz (near Parque Nacional das Emas) 11.XII.1993, V.Viviani col. 1♀ larviform (dissected); 08.XII.1994, 1 larva (dissected), 1♂ (dissected; reared from larva); 28.XI.1996, 1♀ (reared from larva and associated with last larval instar exuvia and eggs), 1♀ (dissected and reared from larva and associated with last larval instar exuvia), 1♂ pupa (reared from larva and associated with last larval instar exuvia). **São Paulo:** São Paulo, Butantã, Horto O. Cruz, 01.X.1969, 1♂ (dissected); São Sebastião, Ilha dos Alcatrazes, 15-17.IV.1994, C.Campaner & R.Francini cols. 2 larvae, 12♀ larviforms (1♀ associated with eggs), 1♂; 29.XI-01.XII.1996, 1♀ larviform. All material housed in the colection of the Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil.



Figs. 23-31. *Phrixothrix hirtus*. Female adult from Costa Rica, MS: 23, habitus, dorsal; 24, habitus, lateral; 25, 4th abdominal spiracle; 26, head, dorsal; 27, head and anterior prothorax, lateral; 28, detail of integument of cephalic capsule; 29, hypopharyngeal sclerome; 30, apex of abdomen, ventral (arrow pointing the ooporus); 31, epipharynx. Scale: figs. 23, 24; 26, 27, 30, respectively to same scale.



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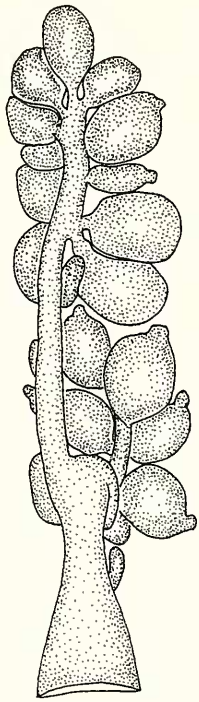

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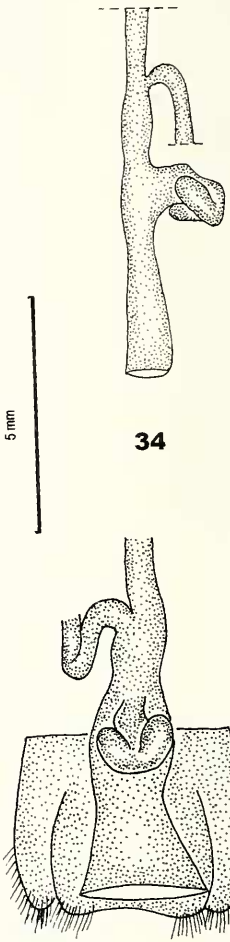

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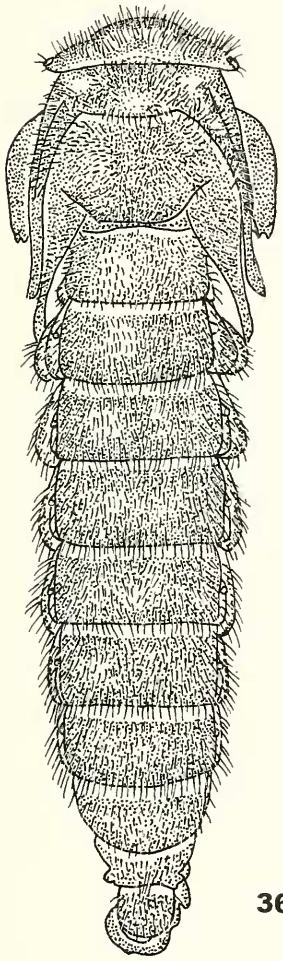
Figs. 32-35. *Phrixothrix hirtus*. Female adult from Costa Rica, MS: 32, schematic representation of reproductive system (hatched), ventral; 33, reproductive system, ventral; 34, vagina, oviduct and spermatheca, lateral; 35, vagina, spermatheca, oviduct and sternite IX, dorsal. Scale: 33-35 to same scale.



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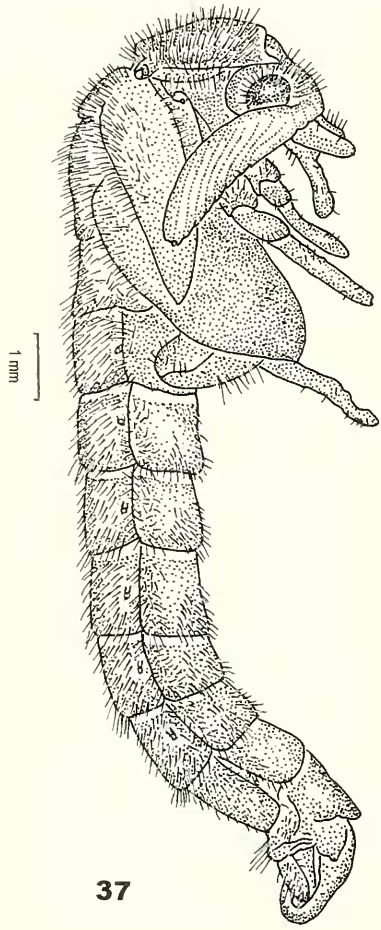

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Figs. 36-37. *Phrixothrix hirtus*. Male pupa from Costa Rica, MS: 36, habitus, dorsal; 37, habitus, lateral.

Remarks. Some structures, important for morphological comparisons, were overlooked by previous workers and have never been studied in detail, or are described for the first time herein, and merit a further discussion.

Male adult. The maxilla of Phengodidae seems to present variation, not only in relation to the shape of palpal segments, but also regarding the number of inner lobes, two, one, or none. In *Phrixotrix hirtus* (fig. 10) two lobes are clearly distinct, the galea and the lacinia. However, in *Phengodes* Hoffmansegg **in** Illiger, 1807, *Euryopa* Gorham, 1881, *Taximastinocerus* Wittmer, 1963 and *Eurymastinocerus*, Wittmer, 1976 a single lobe is present, as can be seen, for instance, in the illustrations provided by ZARAGOZA (1989: figs. 1-4, *Phengodes atezcanus* Zaragoza, 1981, *P. brailovskyi* Zaragoza & Wittmer, 1986, *P. leonilae* Zaragoza & Wittmer, 1986 and *P. tuxtlaenses* Zaragoza, 1989; fig. 27, *Euryopa singularis* Gorham, 1881; fig. 28, *Taximastinocerus brunneus* (Gorham, 1881); fig.29, *Eurymastinocerus niger* (Gorham, 1881), and in *Stenophrixotrix fuscus* (Gorham, 1881) and *Mastinowittmerus mexicanus* Zaragoza,1984, the inner maxillary lobe is absent (ZARAGOZA, 1984: fig. 3; 1989, fig. 26, respectively).

The membranous wing of *Phrixotrix hirtus* (fig. 14) is very similar to that of *P. hieronymi*, illustrated by HAASE (1888). The pattern of venation is alike that of the Lampyridae (**e.g.** KUKALOVÁ-PECK & LAWRENCE ,1993, fig. 64) but having only four veins in the main group instead of five veins, the CuA_{3+4} vein being absent.

The trilobed male genitalia of *P. hirtus* (figs. 19, 20) approachs that of *Chauliognathus* sp., illustrated by SHARP & MUIR (1912: 624 and pl. 64, fig. 139), sharing a reduced, ribbon-like basal piece. However, they differ chiefly by the presence, in phengodids, of an outer flagellum, which remains encircled around the median lobe when at rest. We have not found a similar situation in any other group of Coleoptera.

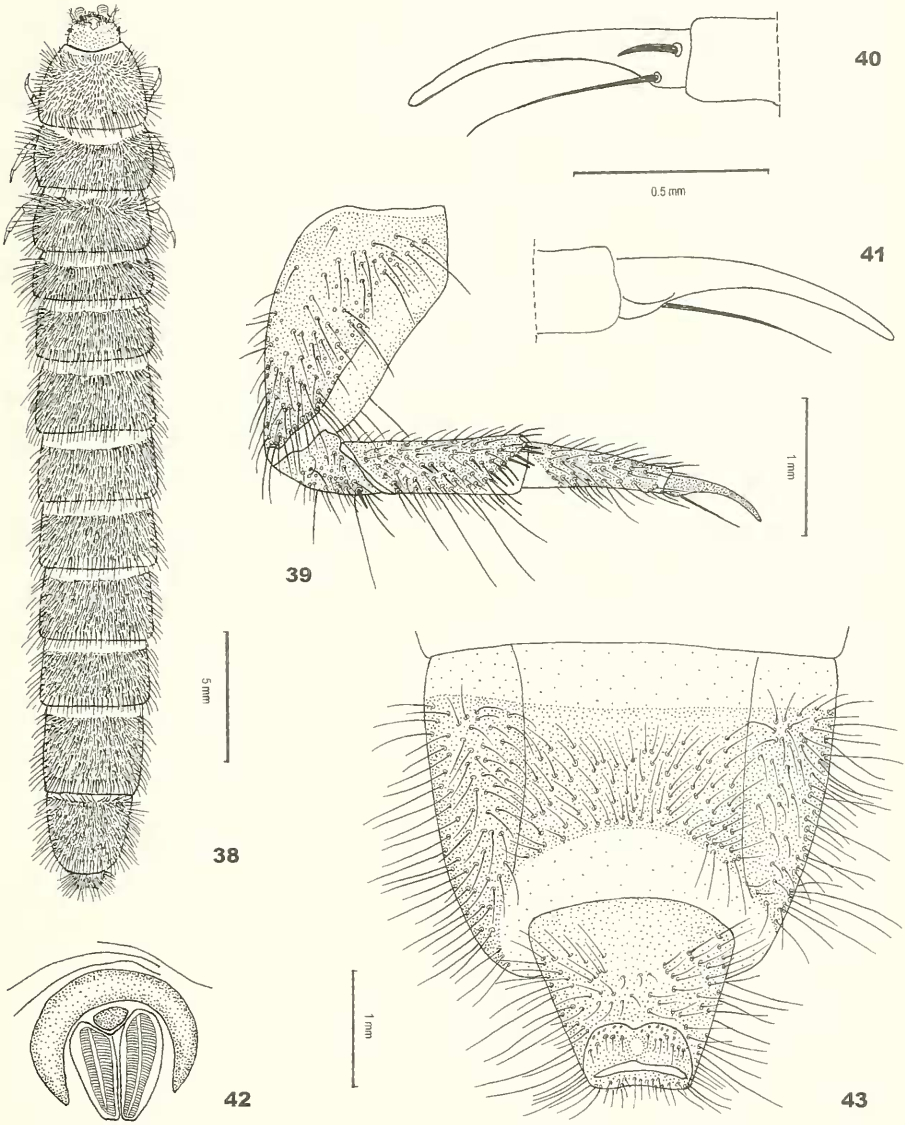
The metendosternite of a phengodid is described and illustrated for the first time. In *P. hirtus* (figs. 16, 17) it is slender and elongate, without protruding furcal arms. It is very similar in shape to that of *Cantharus* sp., described by CROWSON (1938: 404, 405, pl. 7, fig. 5, as *Telephorus* sp.), differing chiefly by the less developed lamina and by the absence of tendons, indistinct in the two specimens of *P. hirtus* examined.

Female adult. Females are easily distinguished from larvae by the presence of an ooporous in the sternite IX, absent in larvae; and by the annular spiracles, biforous in larvae.

The presence of the maxillolabial complex and the oral region densely covered by microtrichiae and setae in both female and larval stages are an adaptation to their liquid feeding.

The single previous description of an adult female of the genus *Phrixotrix* was provided by HAASE (1888), more than a century ago. That author described the female of *P. hieronymi*, based on material from Argentina, and pointed out the great similarity between the first larval instar and the female. He also described the female internal reproductive organs. However, his descriptions are somewhat superficial and lack some important details, essencial to make possible a comparison between that species and *P.hirtus*. The only obvious difference between the two species is related to size: *P.hieronymi* (lenght 18 mm, width 4 mm) and *P. hirtus* (lenght 34 mm, width 5 mm).

TIEMANN (1970) studied the natural history of *P. tiemmani* (cited as *Phrixotrix*



Figs. 38-43. *Phrixothrix hirtus*. Larva from Costa Rica, MS: 38, habitus, dorsal; 39, left metathoracic leg, 40, idem, tarsungulus, outer view; 41, idem, tarsungulus, inner view; 42, first abdominal spiracle; 43, 9th and 10th abdominal segments, ventral. Scale: figs. 40, 41, to same scale.

sp.), giving many informations about the female biology but nothing about its morphology.

According to CROWSON (1981) "the Cantharoidea are noted for the paedomorphic tendencies of their adults, which are particularly marked in the luminous groups". Among them, the Phengodidae-Phengodinae seem to attain the highest level of paedomorphosis, as can be deduced from the descriptions presented above and by TIEMMAN (1967). Phengodinae females retain much more larval features than neotenic females of other Cantharoidea, including the Phengodidae-Rhagophthalminae. In the last group, neotenic females bear compound eyes, 8-segmented antennae, and tarsi subdivided into tarsomeres and with a pair of claws, as can be seen in the illustration of *Rhagophthalmus ohbai* Witmer, 1994, presented in WITTMER & OHBA (1994).

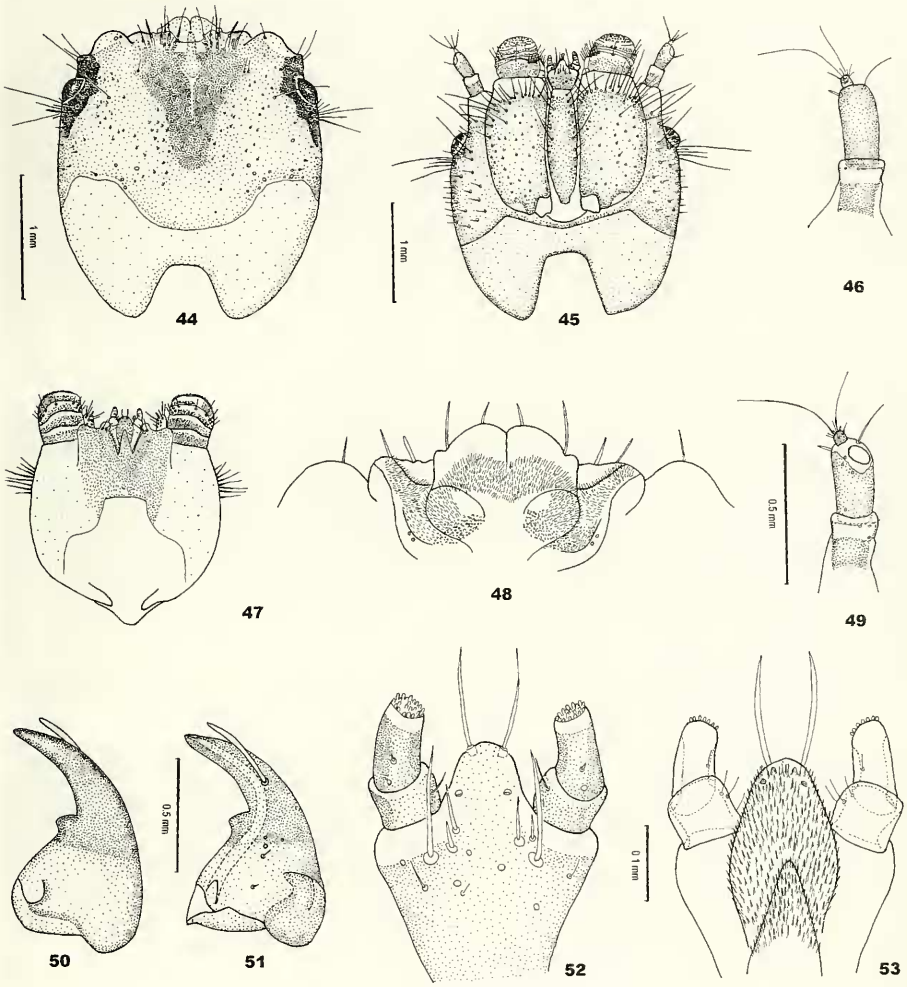
Female pupa. The larviform female pupa of *P. hirtus* can be easily distinguished from the larva and larviform female by the lighter coloration of the integument, and by the mandible triangular-shaped and not sulcate.

Larva. LESAGE (1991), probably based only on the mandible of *Phengodes laticollis*, described and illustrated by PETERSON (1951), stated that the retinaculum of mandible is absent in Phengodidae, and would be present only in Lampyridae. However, the retinaculum is clearly distinct in right and left mandibles of *P. hirtus* (figs. 50, 51) and *Phrixotrix* sp., described and illustrated by COSTA **et al.** (1988).

Comparing *Phrixotrix hirtus* with *Phrixotrix* sp. described by COSTA **et al.** (1988) it can be observed that the coronal suture is present in the former but absent in the latter. The stipites and cardines are separate in the former and fused in the latter. The tarsungulus is different in the two species: all legs of *P. hirtus* have one short and one long seta, instead of two short and one long seta on metathoracic legs and one short and one long seta on the remainder legs.

Geographical distribution. *Phrixothrix hirtus* is known from Paraguay, Argentina and Brazil (WITTMER, 1963). The same author (WITTMER, 1988) reported the species to Venezuela, what seems to be a doubtful record. In Brazil, *P. hirtus* is a common phengodid species found in southeastern Atlantic forests and surrounding fields and also in the central west "cerrados".

Habitat. We have carried out observations on the natural history of *P. hirtus* collected near the Parque das Emas and also in Ilha dos Alcatrazes in the littoral of São Paulo. Field observations and collectings were performed in the former locality during 1992 - 1997 at Fazenda Santa Cruz, Costa Rica, MS, and in the latter during 1994 - 1996. Near the Parque das Emas, males were attracted by light-traps. Larvae and adult females were collected in pastures and into a vegetal formation called "cerradão", which is a kind of savanna with denser and higher trees. Both larvae and females were found by night onto the ground. In Ilha dos Alcatrazes a couple was collected in copula, onto the ground. We have found both larvae and females mainly from November through February near the Parque das Emas, and from November through April in the Ilha dos Alcatrazes.



Figs. 44-53. *Phrixothrix hirtus*. Larva from Costa Rica, MS: 44, cephalic capsule, dorsal; 45, head, ventral; 46, antenna, dorsal; 47, maxillo-labial complex, dorsal; 48, epipharynx; 49, antenna, ventral; 50, mandible, ventral; 51, mandible, dorsal; 52, labium, pars, ventral; 53, hypopharynx and labium (pars), dorsal. Scale: 45, 47; 46, 48, 49; 50, 51; 52, 53, respectively to same scale.

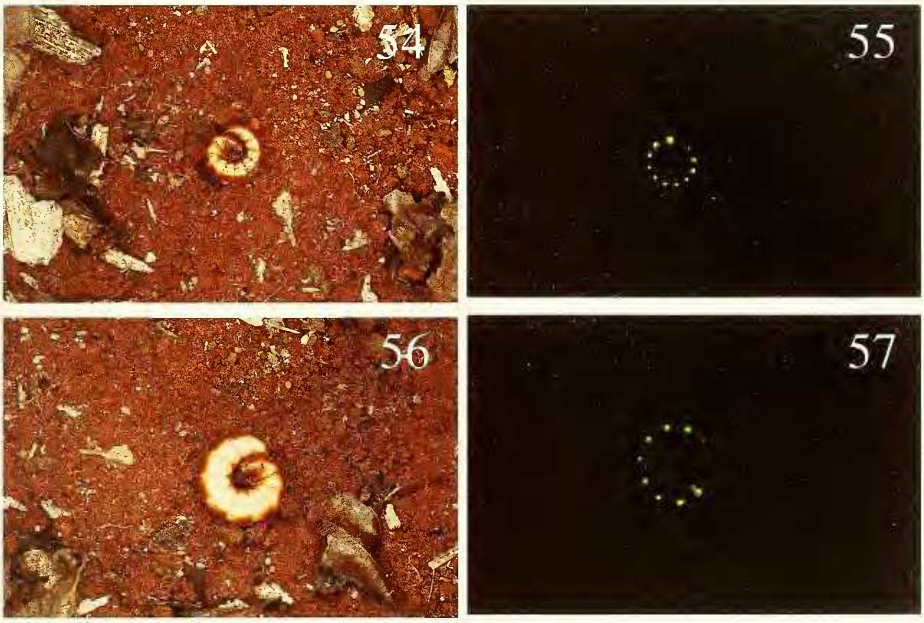
Notes on the life cycle. Few observations gathered during rearing of specimens include a mature larva collected in 8.XII.1994 metamorphosed to a male pupa in 5.I.1995; the adult male appeared in 2.II.1995. The pupal phase lasted 26 days. Two larviform individuals were collected in 28.XI.1996, and pupated in laboratory in 5.XII.1996 and 7.XII.1996, respectively. At the time of pupation they changed the skin and became whitish, but did not suffer any apparent morphological change (figs. 58, 59). During the pupal period they stayed almost quiet and immobile in an encircled position. The female adults emerged in 26.XII.1996 and 30.XII.1996, respectively. The pupal stage lasted 21-23 days. Just after the eclosion, they had an orange pigmentation but they never recovered the original dark pigmentation exhibited by the larvae. About 50 days after its emmergence, one of those females, which was not fecunded , laid 12 round and hard "eggs" that never hatched. This female encircled the "eggs" until its death. Male larvae are similar to female larvae, with the same pattern of dark dorsal pigmentation, but are smaller.

A single female from Ilha dos Alcatrazes lead, in laboratory, 35 eggs which never hatched. TIEMMAN (1970) cited as three dozen the number of eggs oviposited by *P. tiemmani*. The number of eggs oviposited by the not fecunded specimen from near the Parque das Emas (12 eggs) is the same as the number reported by HAASE (1888) for *P. heydeni*.

Luminescence. As other *Phrixothrix* species, larvae of *P. hirtus* have red lights on the head and pairs of lateral lanterns at the edges of the body which emit yellow light. During the observed mating of a couple from Ilha dos Alcatrazes, it was noticed an intense glowing of male and female photophores (C. Campaner, Museu de Zoologia USP, pers. comm.). In two female larvae it was detected an assymmetrically located light organ on the prothorax between the two lateral lanterns. During the pupal stage,

Table I. In vivo bioluminescence spectra peaks of *Phrixothrix hirtus* Olivier, 1909.
* These spectra were recorded in a Spex model Fluorolog spectrofluorometer according to VIVIANI & BECHARA (1995). The live specimens were immobilized into glass cuvettes. Each value reported here result from 3-6 independent measurements. ** These specimens were anesthetized with chloroform during 2 min and injected with 10µl of commercial epinephrine (1 mg/ml) in the dorsal intersegmental region near the light organs.

Life stage/lantern		λ max (nm)*
Larvae	Head (n=5)	635
	Lateral (n=5)	568
Adult females **	Head (n=2)	635
	Lateral (n=2)	571
Male pupa **	Lateral (n=2)	567
Adult male	Lateral (n=1)	568



Figs. 54-57. *Phrixothrix hirtus* from Costa Rica, MS: 54 and 55, male larva; 56 and 57, female larva.

Figs. 58-61. *Phrixothrix hirtus* from Costa Rica, MS: 58 and 59, female pupa; 60 and 61, female larviform adult with eggs.

females retain the red lanterns but males lack them. So, in the female the luminescence pattern is also very similar to the larval one. The females which laid eggs dead a couple of weeks after the oviposition. However, during this time they lacked any movement and become flesh, seeming death, but still retaining the ability to display light emission by lateral lanterns when disturbed, suggesting a protective function to the eggs. Pupal and adult males maintain only lateral lanterns at the edges of the body and a median light organ on the mesothorax. This is the first species in which the bioluminescence spectrum was detected for all life stages (table I). The **in vivo** spectra for the lateral lanterns of all life stages is essentially similar. Also, the larval and adult females head lantern bioluminescence spectra are identical.

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